



# Prevalence of cholera risk factors between migrant Haitians and Dominicans in the Dominican Republic

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## ABSTRACT

**Objective.** To determine whether cholera risk factor prevalence in the Dominican Republic can be explained by nationality, independent of other factors, given the vulnerability of many Haitians in the country and the need for targeted prevention.

**Methods.** A cross-sectional, observational household survey (103 Haitian and 260 Dominican) was completed in 18 communities in July 2012. The survey included modules for demographics, knowledge, socioeconomic status, and access to adequate water, sanitation, and hygiene (WASH) infrastructure. Logistic regression assessed differential access to WASH infrastructure and Poisson regression assessed differences in cholera knowledge, controlling for potential confounders.

**Results.** Dominican and Haitian households differed on demographic characteristics. Haitians had lower educational attainment, socioeconomic status, and less knowledge of cholera than Dominicans (adjusted odds ratio [aOR] = 0.66; 95% confidence interval [95%CI] = 0.55–0.81). Access to improved drinking water was low for both groups, but particularly low among rural Haitians (aOR = 0.21; 95%CI: 0.04–1.01). No differences were found in access to sanitation after adjusting for sociodemographic confounders (aOR = 1.00; 95%CI: 0.57–1.76).

**Conclusions.** Urban/rural geography and socioeconomic status play a larger role in cholera risk factor prevalence than nationality, indicating that Haitians' perceived vulnerability to cholera is confounded by contextual factors. Understanding the social dynamics that lead to cholera risk can inform control strategies, leading to better targeting and the possibility of eliminating cholera from the island.

## Key words

Cholera; water supply; sanitation; socioeconomic factors; Dominican Republic; Haiti.

Cholera is a diarrheal illness caused by the bacterium *Vibrio cholerae*. In its most severe form, cholera leads to dramatic

fluid loss, and if left untreated, death (1). Spread by the fecal-oral route, cholera transmission is easily interrupted with access to safe drinking water and basic sanitation (2). For these reasons, residents of many low- and middle-income countries with inadequate coverage of water, sanitation, and hygiene (WASH) infrastructure remain particularly vulnerable to infection with diarrheal pathogens such as cholera (3).

Consumption of untreated surface water (rivers, irrigation channels, and unprotected wells) plays a major role in cholera transmission, while household water treatment (such as chlorination or boiling), hand washing with soap, and improved sanitation are the best protection against infection (4, 5). Additionally, recognition of symptoms and transmission routes is likely to lead individuals to seek care in health facilities.

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ties, but only if the health care system is trusted.

Cholera was introduced to Haiti in October 2010, and rapidly spread across the island of Hispaniola, reaching the Dominican Republic within a month (6). In 2011, Haiti experienced more than 500 000 cholera cases and approximately 7 000 deaths, while the Dominican Republic reported 20 000 cases and 371 deaths (7). The severity of the epidemic in Haiti resulted from a nationwide lack of WASH infrastructure—only 26% of the population has access to improved sanitation and 64% uses a safe drinking water source (8). In contrast, sanitation and safe water coverage in the Dominican Republic is much higher—82% for both indicators (9).

Relations between Haiti and the Dominican Republic are marked by a long history of migration. Contemporary migration patterns on Hispaniola, coupled with shortcomings in WASH infrastructure, likely facilitated cholera's spread to the Dominican Republic (10). While migrant Haitians comprise an essential labor force in the Dominican economy, they are a marginalized population.

Given their longstanding socioeconomic vulnerability, migrant Haitians appear to be at a disproportionate risk for cholera infection, comprising 20% of cholera cases reported in the Dominican Republic in 2011 (7). The socioeconomic position of migrant Haitians in the Dominican Republic likely impacts their risk for infectious diseases, such as cholera. However, the circumstances surrounding cholera's emergence in the Dominican Republic have also exacerbated pre-existing nationalistic and racial tensions between the two countries, resulting in cholera-related stigma, and even, forced expulsions of Haitian migrants and Dominicans of Haitian descent (11).

Indeed, nationalism and racism are interwoven and historically rooted in Dominican society (12, 13), and cholera's epidemiology on the island has, to some extent, perpetuated anti-Haitian sentiments (14). During cholera outbreaks in other settings, certain racial, ethnic, and impoverished groups who had long-endured socioeconomic vulnerability from structural violence were also blamed for cholera's spread (15, 16). Therefore, public health efforts that address cholera must be sensitive to the possibility of inadvertently blaming a

certain racial or socioeconomic group for the disease's emergence.

The objective of this study was to determine if cholera risk factors are more prevalent among migrant Haitians or Dominicans living in the Dominican Republic. In light of cholera's effect on pre-existing tensions between Haitians and Dominicans, particularly its support of mainstream discourse that links race or nationality to disease, this study aimed to identify which, if any, cholera risk factors could be explained by nationality, and which of those factors existed independent of other confounders, such as socioeconomic status, geography (rural/urban), and education level. Moreover, the characterization of differential risks for cholera among demographic groups is essential to effectively allocating public health resources and developing culturally-sensitive strategies and policies for eradicating cholera from the island of Hispaniola, a goal articulated by the Pan American Health Organization (PAHO) (17).

## MATERIALS AND METHODS

### Study design

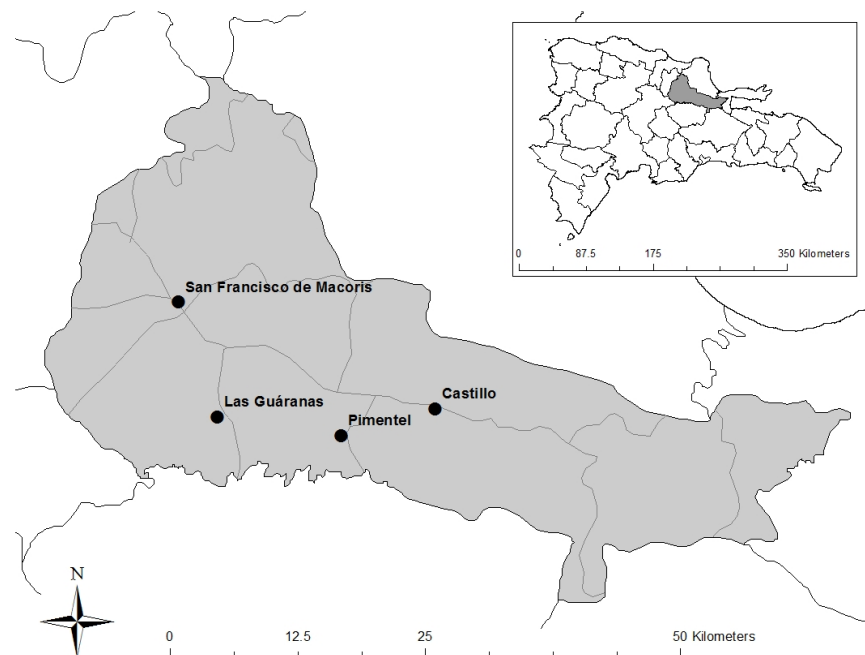
This was a cross-sectional, observational study that took place in four mu-

nicipalities in the Duarte Province, Dominican Republic. Eighteen communities within these municipalities were selected based on recommendations from the provincial Ministry of Health office that identified these as particularly vulnerable to cholera or having a mixed Haitian-Dominican population (Figure 1). A sample size of 360 was chosen based on a 20 × 18 cluster design, determined to be sufficient to detect a 15% difference in risk factor prevalence at a 95% confidence interval (95%CI) with 80% power (18).

### Sampling procedure

Households within each community were randomly selected using a random-walk method (19). From a central point in each community, a pen was spun on the ground to determine the direction of sampling. Systematic sampling was then conducted along that direction using a randomly generated sampling interval. A population-based sampling interval was not possible since population data at the community level were not available. Population size was adjusted for by using weights in the analysis. At each house, enumerators asked to speak with the person in the household considered to know the most about health. The sur-

**FIGURE 1.** Locations of municipalities surveyed in the Duarte province to assess cholera risk factors among migrants in the Dominican Republic, 2012



vey was administered to that individual. Data were collected from 8–15 July 2012.

### Survey instrument

The survey included modules for: basic demographics; knowledge of cholera symptoms and transmission, based on educational materials disseminated by the Ministry of Health; occurrence of cholera cases in the household; socioeconomic status based on household characteristics; access to WASH infrastructure; and the household's WASH-related practices.

Responses to cholera knowledge questions were used to create a numerical knowledge score (higher scores indicated greater knowledge). Respondents were asked to identify, from memory, cholera symptoms and transmission routes, while enumerators marked responses on a coded list. Each correct response was awarded one point, while incorrect responses or a response of "I don't know" were awarded zero points.

Socioeconomic measures were collected that included household assets and structural characteristics of the home. WASH practices were assessed through a combination of closed-ended questions and observations. Responses were categorized according to the World Health Organization (WHO) Joint Monitoring Program for Water and Sanitation improved-unimproved criteria (20). More information on the calculation of socioeconomic status and numerical scores of cholera knowledge is available (see [Supplementary material](#): Composite Measures).

### Data processing and analysis

Survey data were double-entered into two separate spreadsheets using Microsoft Excel™ (Microsoft Corporation, Redmond, Washington, United States). Excel Compare (Formula Software Incorporated, Barnaul, Russia) identified inconsistencies between the two files, and original surveys were consulted to resolve discrepancies. Following data collection, the quadrat method was used to obtain population estimates for use in analysis (21). All analyses incorporated post-stratification weights generated from these population estimates. Multiple imputations ( $n = 5$ ) were performed on four variables so that regression analyses could account for the complex sampling design, and produce

valid estimates. Details on population estimates, post-stratification weighting, and multiple imputation are available ([Supplementary material](#): Population Estimates and Multiple Imputation). All statistical analyses were conducted using SAS 9.3 (SAS Institute Incorporated, Cary, North Carolina, United States).

Logistic regression was used to quantify differences in demographic characteristics between Dominicans and migrant Haitians and between residents of urban and rural communities. These analyses accounted for weighting and sample design. Weighted percentages, which are representative of the overall population of the 18 surveyed communities, are reported with 95%CI.

Self-reported nationality was the independent variable of interest. Three logistic regression models assessed differential access to household WASH infrastructure. Dependent variables included whether a household had: (a) an improved drinking water source, (b) an improved toilet facility, and (c) a hand-washing facility ([Supplementary material](#): Composite Measures). Since the knowledge score was in essence count data, a Poisson regression was employed for this outcome. All models controlled for three potential confounders specified *a priori*: socioeconomic status, educational attainment, and urban/rural geography. Effect modification of urban/rural geography on nationality was also explored for all four outcomes.

### Ethical considerations

Research was conducted through a partnership between the Universidad Autónoma de Santo Domingo (Santo Domingo, Dominican Republic) and Emory University (Atlanta, Georgia, United States) with assistance from the provincial office of the Ministry of Health of Haiti. The field team was comprised of United States-based researchers, all proficient in Spanish, with one proficient in Haitian Kreyòl. Haitian and Dominican enumerators were recruited from the local, partnering university to collect survey data in their native language.

## RESULTS

### Demographics

The sample comprised 260 Dominican households and 103 Haitian households

( $n = 363$ ). Only 2 households (0.6%) reported a case of cholera within the previous 18 months. Haitians and Dominicans differed substantially on several demographic characteristics (Table 1). Dominican respondents were more frequently female (crude odds ratio [cOR] = 0.15; 95%CI: 0.08–0.28). Haitian respondents were younger (mean 31.1 years) than Dominicans (mean 43.6 years). Educational attainment was also lower among Haitians. The majority of Haitians (70.6%) reported no more than primary education, while more than half of Dominicans (57.8%) had at least a secondary education. Haitian respondents were predominantly undocumented (71.0%).

Socioeconomic disparities were also apparent. Nearly all Haitian households surveyed (93.1%) fell into the lowest two socioeconomic quintiles, and almost half of Dominicans (44.9%) were in the highest socioeconomic quintile (Table 1). Haitian households were also less frequently found in urban communities (34.5%) than were Dominican ones (51.7%; Table 1).

### WASH risk factors

WASH infrastructure and knowledge also differed significantly between Haitians and Dominicans. Access to an improved water source was low among both groups (approximately 20%), but did not differ between them (cOR = 0.94; 95%CI: 0.62–1.43; Table 1). Access to sanitation was higher among Dominicans (70.5%) than Haitians (38%). Hand-washing facilities were available in less than half of both Haitian and Dominican households, but were slightly more common among Dominicans (cOR = 1.42; 95%CI: 0.89–2.26; Table 1). Dominicans were generally more knowledgeable about cholera, registering a median knowledge score of 3.22 (interquartile range [IQR] = 1.54–4.87) compared to a median of 2.24 (IQR = 0.11–3.22) among Haitians.

### Urban/rural geography

Urban/rural differences in demographic and cholera risk factor frequencies were present (Table 2). Educational attainment was lower in rural areas, with 74.3% of rural respondents reporting no more than primary schooling; and higher in urban ones, with nearly 50% of urban residents reporting at least a secondary education. Urban households were more likely to have improved sanitation facili-

**TABLE 1. Frequencies of demographic and risk factor variables among Dominicans and Haitians in a study of cholera risk, by nationality, Dominican Republic, 2012**

	Dominican <sup>a</sup>		Haitian		cOR <sup>b</sup>	95%CI
	Percent	95%CI	Percent	95%CI		
<b>Demographics</b>						
Geographic setting						
Urban	51.7	48.3–55.1	34.5	28.6–40.3	5.26	3.08–9.00 <sup>c</sup>
Household size (people)						
1–2	20.6	13.5–27.7	31.1	18.2–44.1	REF	REF
3–5	64.6	56.5–72.7	54.3	40.1–68.5	0.53	0.25–1.13
≥ 6	14.7	9.8–19.7	13.1	2.6–23.6	0.56	0.19–1.71
Respondent age (years)						
18–24	16.2	9.6–22.8	24.1	11.7–36.4	REF	REF
25–34	24.5	17.3–31.7	49.0	34.6–63.4	1.29	0.52–3.17
35–44	20.9	14.4–27.4	19.3	7.9–30.7	0.59	0.21–1.68
45–54	9.9	5.8–14.0	3.2	0.0–6.9	0.21	0.05–0.90 <sup>c</sup>
≥ 55	28.5	20.9–36.2	3.4	0.2–6.6	0.08	0.02–0.26 <sup>c</sup>
Respondent gender						
Female	74.7	67.1–82.3	30.1	20.1–40.2	0.15	0.08–0.28 <sup>c</sup>
Respondent education						
None	12.3	7.0–17.6	14.3	4.9–23.7	REF	REF
Primary	49.4	41.3–57.5	56.3	42.1–70.5	0.98	0.38–2.51
Secondary +	38.3	30.8–45.9	29.4	15.9–42.9	0.66	0.24–1.85
Socioeconomic quintile						
Lowest two	18.6	12.1–25.1	93.1	88.0–98.1	REF	REF
Middle	26.5	19.3–33.7	6.6	1.6–11.6	0.05	0.02–0.13 <sup>c</sup>
Highest two	54.9	46.9–63.0	0.4	0.0–0.9	0.001	0.000–0.006 <sup>c</sup>
<b>Risk factors</b>						
Improved water	19.8	13.1–26.5	20.2	10.2–30.3	0.94	0.62–1.43
Improved sanitation	70.5	63.1–77.9	37.9	24.5–51.3	0.75	0.48–1.18
Hygiene facility	42.0	34.1–49.8	31.5	18.0–45.1	1.42	0.89–2.26
Knowledge score						
None (0)	7.9	4.1–11.7	23.8	16.4–31.3	REF	REF
Low (1–4)	52.6	44.1–61.1	63.5	51.1–75.9	1.57	0.82–2.98
High (5–8)	39.5	31.1–47.9	12.7	2.3–23.1	0.22	0.08–0.60 <sup>c</sup>

<sup>a</sup> Reference category for cOR calculations.

<sup>b</sup> Crude odds ratio.

<sup>c</sup> Significant at  $\alpha < 0.05$ .

ties (cOR = 4.38; 95%CI: 2.26–8.47; Table 2) and hand-washing facilities (cOR 2.83; 95%CI: 1.43, 5.62; Table 2), but less likely to have improved water sources (cOR = 0.35; 95%CI: 0.16–0.74; Table 2).

### Adjusted regression analyses

Associations between cholera risk factors and nationality changed when controlling for potential confounders and testing for urban/rural effect modification (Table 3). Access to improved water did not differ between Haitians and Dominicans after adjusting for confounders (aOR = 0.77; 95%CI: 0.46–1.27). However, a test for urban/rural effect modification indicates that rural Haitians experience more difficulty accessing improved water than Dominicans and urban Haitians (aOR = 0.21; 95%CI:

0.04–1.01). There was no difference in improved sanitation access between Haitians and Dominicans after controlling for socioeconomic status, participant education, and urban/rural geography (aOR = 1.00; 95%CI: 0.44–1.57), nor evidence of urban/rural modification ( $P = 0.18$ ). However, Haitians were significantly more likely to have access to hygiene infrastructure than Dominicans (aOR = 1.78; 95%CI: 1.07–2.96), an effect that was significantly modified by urban/rural geography ( $P < 0.01$ ; Table 3). Likelihood of access to hygiene infrastructure among Haitians was greater in rural areas (aOR = 6.57; 95%CI: 1.72–25.17) than in urban areas (aOR = 0.92; 95%CI: 0.56–1.52). Haitians had lower knowledge of cholera compared to Dominicans (crude risk ratio [cRR] = 0.66; 95%CI: 0.47–0.86),

a result that was not affected by confounding or urban/rural effect modification ( $P = 0.67$ ; Table 3).

## DISCUSSION

This study explored the distribution and prevalence of cholera risk factors in urban and rural communities of Duarte Province, Dominican Republic, and compared those risk factors between migrant Haitian and Dominican households. Our goal was to understand if differences in WASH access could be explained solely by nationality, and the extent to which this risk was confounded by other factors such as socioeconomic status, geography, and educational attainment. Teasing out these related characteristics may help policymakers and planners better develop and target cholera mitigation strategies among vulnerable populations in the Dominican Republic. While Haitian and Dominican households differ on many demographic characteristics, differences in access to WASH infrastructure disappeared when accounting for these confounding characteristics. Socioeconomic and geographic conditions appeared more associated with WASH infrastructure than with nationality itself. In contrast, knowledge of cholera was lower among Haitian respondents than Dominicans, regardless of socioeconomic and geographic conditions. Observed disparities in socioeconomic, educational, and geographic characteristics between Haitian and Dominican households, rather than nationality alone, appear to explain disparities observed in the prevalence of cholera risk factors.

### Water and sanitation

In both urban and rural areas and among both Haitians and Dominicans, use of an improved source of primary drinking water was low. This is due, in part, to the common use of bottled water, which the Joint Monitoring Program considers an unimproved source (20). In anecdotal accounts, both Haitian and Dominican participants expressed mistrust of the piped water system due to poor municipal accountability for safe water provision. The majority of residents purchase bottled water. Given the extreme socioeconomic conditions of Haitian households in our sample, purchasing bottled water for drinking



**TABLE 2. Frequencies of demographic and risk factor variables by urban/rural geography in a study of cholera risk, Dominican Republic, 2012**

	Urban <sup>a</sup>		Rural		cOR <sup>b</sup>	95%CI
	Percent	95%CI	Percent	95%CI		
<b>Demographics</b>						
Nationality						
Haitian	5.6	4.1–7.1	23.8	15.5–32.0	5.26	3.08–9.00 <sup>c</sup>
Household size (people)						
1–2	16.2	9.6–22.8	29.2	17.7–40.7	REF	REF
3–5	64.0	55.2–72.8	62.2	50.4–74.1	0.532	0.25–1.14
≥ 6	19.8	12.6–27.0	8.1	2.8–13.5	0.225	0.08–0.62 <sup>c</sup>
Respondent age (years)						
18–24	18.6	11.1–26.0	15.7	6.5–25.0	REF	REF
25–34	24.4	16.5–32.2	32.2	21.3–43.1	1.583	0.61–4.1
35–44	22.9	14.9–30.8	18.0	9.5–26.6	0.946	0.34–2.63
45–54	11.8	6.3–17.4	5.4	1.2–9.7	0.549	0.17–1.83
≥ 55	22.1	14.5–29.7	28.6	16.6–40.7	1.553	0.55–4.37
Respondent gender						
Female	69.5	60.9–78.1	67.3	56.2–78.4	0.904	0.473–1.726
Respondent education						
None	10.2	4.8–15.5	15.5	7.2–23.8	REF	REF
Primary	43.4	34.3–52.4	58.8	47.0–70.6	0.89	0.36–2.21
Secondary +	46.5	37.4–55.6	25.7	15.3–36.1	0.36	0.14–0.95 <sup>c</sup>
Socioeconomic quintile						
Lowest two	23.7	16.5–30.8	35.2	24.1–46.2	REF	REF
Middle	25.0	17.1–33.0	22.2	12.2–32.1	0.61	0.28–1.36
Highest two	51.3	42.3–60.3	42.6	30.3–55.0	0.57	0.29–1.15
<b>Risk factors</b>						
Improved water	12.4	6.6–18.2	28.9	17.8–40.0	0.35	0.16–0.74 <sup>c</sup>
Improved sanitation	80.4	73.8–87.0	48.4	35.7–61.0	4.38	2.26–8.47 <sup>c</sup>
Hygiene facility	41.3	32.6–50.1	18.1	9.5–26.8	2.83	1.43–5.62 <sup>c</sup>
Knowledge score						
None (0)	10.9	5.8–16.1	9.1	4.8–13.4	REF	REF
Low (1–4)	49.3	40.1–58.5	59.9	48.0–71.8	1.46	0.67–3.18
High (5–8)	39.8	30.6–49.0	31.0	19.2–42.8	0.94	0.39–2.23

<sup>a</sup> Reference category for cOR calculations.

<sup>b</sup> Crude odds ratio.

<sup>c</sup> Significant at  $\alpha < 0.05$ .

is an unstable means for procurement. Under economic constraints, many Haitians likely are forced to draw water from open sources, such as collection containers and irrigation canals. Personal observations by the research team revealed that canals were often used for

overt drainage of latrines, while Haitian participants described using canal water out of economic necessity (22).

Our results reveal that drinking water access in Duarte Province can be explained as much by socioeconomic status, geography, and education as

by nationality. Future cholera control and elimination efforts should focus on equitable and sustainable provision of drinking water in communities with unreliable or unstable water supplies. In particular, rural communities' dependence on irrigation canals for drinking water is a major risk factor for infection. Cholera elimination strategies that specifically target the poor and rural communities that depend on irrigation canals for their water supply could address the problem of unstable and unsafe procurement. Such interventions in poor, rural communities would benefit both Haitians and Dominican residents, reducing the risk of cholera and other diarrheal pathogens, and potentially alleviating the cholera-related stigma felt by many Haitians living in the Dominican Republic.

While crude estimates indicate that migrant Haitians suffer from low access to improved sanitation, this appears largely a result of the socioeconomic differences between them and Dominicans. Social determinants have become increasingly important to the understanding of cholera dynamics. Associations between socioeconomic status, environmental conditions, and cholera prevalence were identified during the 1990s epidemic in Latin America (23), while recent work in Bangladesh addressed this relationship more directly through a longitudinal analysis (24). In this study, socioeconomic status explained more variation in cholera occurrence than any other variable, including sanitation (24). The multidimensionality of socioeconomic status could thus serve as a proxy for many of cholera's environmental and social risk factors, including those related to WASH infrastructure, and has been proposed as a central risk factor for cholera (13). Consequently, observed

**TABLE 3. Measures of effect and 95% confidence intervals (95%CI) for logistic and Poisson regression models of cholera risk factors of interest with respect to self-reported nationality. Adjusted models account for education, socioeconomic status, and urban/rural geography. Urban/rural stratification indicates test for effect modification. Dominican Republic, 2012**

Outcome	Crude		Adjusted		Urban		Rural		P value <sup>a</sup>
	cOR	95%CI	aOR	95%CI	aOR	95% CI	aOR	95%CI	
Water	0.94	0.62–1.43	0.77	0.46–1.27	1.38	0.76–2.23	0.21	0.04–1.01	0.05
Sanitation	0.75	0.48–1.18	1.00	0.44–1.57	0.73	0.42–1.28	2.45	0.67–8.97	0.18
Hygiene	1.42	0.8–2.26	1.78	1.07–2.96 <sup>b</sup>	0.92	0.56–1.52	6.57	1.72–25.17 <sup>b</sup>	0.006 <sup>b</sup>
Knowledge <sup>c</sup>	0.65	0.54–0.79 <sup>b</sup>	0.66	0.47–0.86 <sup>b</sup>	0.68	0.45–0.92 <sup>b</sup>	0.94	0.65–1.23	0.67

<sup>a</sup> Wald test for effect modification.

<sup>b</sup> Indicates significance at  $\alpha < 0.05$ .

<sup>c</sup> Adjusted rate ratio (aRR).

disparities in access to improved sanitation indicate that the primary difference between Haitians and Dominicans in the Dominican Republic is position in society. With socioeconomic status comprising a fundamental difference between the two groups, improvements to standards of living for migrant Haitians, particularly in rural and agricultural settings, should be central to cholera control and elimination strategies.

## Hygiene

This analysis revealed that Haitian households were more likely to have access to a hygiene facility. This effect was modified by urban/rural geography, such that Haitians in rural areas were much more likely than Haitians in urban ones to have hygiene infrastructure in their homes. Field observations in this study do not support this conclusion, as hygiene infrastructure was infrequently available, if not entirely absent, in rural communities. This finding is similarly not supported by existing literature. It is possible that rural Haitian respondents interpreted the survey question differently than expected, and households that utilized the irrigation canal for hand-washing answered “yes” when asked if they had a place for hand-washing. Since hand hygiene is highly dependent on available water supply, we would expect water and hygiene results to be similar in direction and magnitude (25, 26). The most readily available water supply in many rural communities is the irrigation canal, a source of surface water with high risk of contamination (4, 5).

## Knowledge of cholera

Cholera knowledge among Haitians was lower than among Dominicans, even when controlling for other demographic characteristics. Knowledge scores were based on information prepared and distributed by the Ministry of Health of the Dominican Republic. Consequently, differences in cholera knowledge observed between Haitians and Dominicans may be the result of ineffective reach by the Ministry’s cholera education messages in migrant Haitian communities.

Low cholera knowledge among migrant Haitians reflects several possible barriers to health communication. Poor knowledge among Haitians may also reflect difficulty reaching a marginalized

population within Dominican society. Fear of deportation or mistreatment may drive migrant Haitians to avoid contact with any authority. As a result, they may avoid contact with health authorities unless absolutely necessary (27).

Linguistic, literacy, and cultural barriers can contribute to low cholera knowledge among migrant Haitians (28, 29). Spanish proficiency among Haitians varies greatly depending on length of time spent in the Dominican Republic, and Spanish-language messaging may not reach Haitians with low language proficiency (27). To address language barriers, the Dominican Ministry of Health has created and distributed cholera education materials in Haitian Kreyòl, but these materials relied heavily on text, rendering the content inaccessible to the large proportion of migrant Haitians with little or no education (30). Similarly, traditional beliefs about disease causation among Haitians may differ from biomedical explanations of cholera transmission tested in the survey (31), such that some Haitians may delay or seek care elsewhere.

In addition to these barriers, Haitians encounter substantial barriers to health care (29). Many avoid seeking health care, drastically limiting opportunities to communicate cholera prevention information in the clinical setting, and reaching only the minority of Haitians covered by the national insurance program or those able to afford fee-for-service care (29, 30). These results emphasize the importance of tailoring health messaging to the social, political, and geographic context of the country’s migrant Haitian population (32). Radio messages were successful in promoting cholera prevention in Haiti (33). Despite the effectiveness of this approach in Haiti, our survey results indicated that few Haitian households own a radio and fewer still receive health information via this medium. In the Dominican Republic, effective communication with migrant Haitian populations in the province may be best accomplished through a community-based approach that incorporates local community leaders to educate community members (29, 34).

## Limitations

The cross-sectional nature of the survey precludes inference of causal relationship, while the relatively small

sample size limits the precision of the estimates. Limitations of sample size also made the detailed examination of certain risk factors, such as exposure to surface water, impossible. Exposure to surface water, either through bathing or drinking, is considered a major risk factor in the current pandemic. This exposure was infrequent in our sample, but appeared to be more common in rural areas and among Haitians. In future studies, surface water exposure may be an important consideration in assessing cholera risk in highly vulnerable communities. Additionally, rural focus group participants reported that men who work in the rice fields commonly drink water from the canal. This emphasizes the importance of examining holistic exposure scenarios, since inadequate WASH infrastructure may be present not only at home, but also in schools and workplaces. A household-level investigation neglects cholera risk factors encountered in the work place. In addition, in 9 communities there were no Haitian households enrolled, and Haitian research assistants completed surveys with Dominican respondents ( $n = 78$ ), a potential source of response bias.

## Conclusions

While migrant Haitians comprise an impoverished and marginalized section of Dominican society, vulnerability to cholera infection extends well beyond distinctions of nationality. Socioeconomic and geographic factors play a central role in cholera risk in the Dominican Republic, such that both Dominicans and migrant Haitians residing in impoverished, rural communities are especially vulnerable. As a result, health programs in the Dominican Republic must consider the impact of these socioeconomic disparities and develop messaging and control programs that account for them. Major areas to address are shortcomings in basic services, including WASH infrastructure and access to healthcare facilities. In addition, behavior change communication strategies may be useful, but they should avoid singling out certain groups (such as the poor, or migrant Haitians), with the implicit message that failure to enact such behaviors implies a fault of their own (15). Ultimately, a productive step toward eliminating cholera from Hispaniola would be to challenge racialized or nationalistic discourse, and

instead frame cholera as a disease that thrives amidst socioeconomic disparity, thereby necessitating collaborative action among all members of society.

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## Prevalencia de los factores de riesgo de cólera entre los inmigrantes haitianos y los dominicanos en la República Dominicana

### RESUMEN

**Objetivo.** Determinar si la prevalencia de los factores de riesgo de cólera en la República Dominicana puede explicarse por la nacionalidad, independiente de otros factores, dada la vulnerabilidad de muchos habitantes haitianos que viven en el país y la necesidad de actividades de prevención orientadas.

**Métodos.** En julio del 2012, se llevó a cabo una encuesta domiciliaria transversal y de observación (103 hogares haitianos y 260 hogares dominicanos) en 18 comunidades. La encuesta incluía módulos sobre características demográficas, conocimientos, nivel socioeconómico y acceso a una infraestructura adecuada de agua, saneamiento e higiene (WASH). Mediante regresión logística, se evaluaron las diferencias de acceso a una infraestructura de WASH y, mediante regresión de Poisson, se evaluaron las diferencias en materia de conocimientos sobre el cólera, con control de los potenciales factores de confusión.

**Resultados.** Los hogares dominicanos y haitianos diferían en cuanto a características demográficas. Los segundos mostraban un nivel educativo inferior, una peor situación socioeconómica y menores conocimientos sobre el cólera que los hogares dominicanos (razón de posibilidades ajustada [ORa] = 0,66; intervalo de confianza de 95% [IC95%] = 0,55–0,81). El acceso a agua potable mejorada fue bajo en ambos grupos pero particularmente entre los hogares haitianos rurales (ORa = 0,21; IC95%: 0,04–1,01). No se observaron diferencias en cuanto al acceso al saneamiento después de ajustar para los factores de confusión sociodemográficos (ORa = 1,00; IC95%: 0,57–1,76).

**Conclusiones.** La geografía urbana o rural y el nivel socioeconómico repercuten más ampliamente en la prevalencia de los factores de riesgo de cólera que la nacionalidad, lo que indica que la vulnerabilidad percibida de los habitantes haitianos al cólera se confunde por factores contextuales. La comprensión de la dinámica social que conduce al riesgo de cólera puede servir de base a las estrategias de control, y llevar a una mejor orientación de las iniciativas y a la posibilidad de eliminar el cólera de la isla.

### Palabras clave

Cólera; abastecimiento de agua; saneamiento; factores socioeconómicos; República Dominicana; Haití.